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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON

Letter
Circular
LC798

August 18, 1945

PLASTIC PAINT

The Bureau receives numerous requests from the public for information on plastic paint. These requests have increased in recent years because of the appearance on the market of a group of coatings described as "plastic paints" and which are generally offered at high prices.

A type of paint known as plastic or texture paint, for decorating interior walls, has been on the market for at least twenty-five years. This is a heavy-bodied paint that can be applied with a brush, trowel, or sponge. Variations in texture to obtain such effects as caenstone, travertine, etc., are obtained by troweling, stippling, brushing, knifing and wiping. The paint can be obtained as an oil-base or a water-base material. The oil-base paint may be composed of white Portland cement, sand, lithopone and asbestos ground in linseed oil together with certain stabilizers. The water-base paint is generally a powder composed of casein, hydrated lime, mica, lithopone, clay, etc. It is mixed with water for use.

Likewise a type of paint sometimes designated as plastic paint, for waterproofing exterior masonry surfaces, has been available for at least twenty-five years. This type of coating has the consistency of thick paint. It generally consists of various pigments mixed with asbestos fiber, ground in a vehicle containing resins and tung oil. The paint is applied with a stiff brush and on average masonry surfaces the spreading rate is about fifty square feet to the gallon. This is many times the thickness of an ordinary paint coating. Thus the material fills any small hair line cracks, pores and voids in the masonry surface.

Recently another type of so-called "plastic paint" has appeared on the market. This paint is of the usual brushing consistency, and is offered under various brand names, and at unusually high prices. It is sold for both indoor and outdoor use. Some of these paints are described as being "liquid plastics"- by inference apparently referring to the raw materials used in the manufacture of plastics.

Many of the raw materials used in the manufacture of plastics have long been known and used in the protective coating industry. Technically all paints may have certain plastic properties. However, there has been no official definition or specification prepared for the term "plastic paint." It would seem that a discontinuance of this term as applied to ordinary oil and oleoresinous paints (with the expectation of "cashing in" on the word "plastics") would be desirable.

Doubtless the suggestion that coatings that really contain a major portion of raw materials used in the plastics industry should be entitled to the proper use of "plastics" in describing them has considerable merit. For example, the baked coating on the inside of metal beer cans is mainly a solution of vinyl resin. The baked coating on the outside of mechanical refrigerators is mainly a solution of melamine-urea formaldehyde and alkyd resins mixed with pigment. The modern luminous (phosphorescent) paint is mainly a solution of a synthetic resin such as acrylic resin or polystyrene resin and pigment. The baked coating on the inside of steel potable water tanks is frequently a solution of a heat convertible pure phenolic resin with or without pigment. The major portion of a clear nitrocellulose lacquer is a solution of nitrocellulose and a synthetic resin such as alkyd resin. All of these examples and many others of a similar nature might be classed as plastics-base coatings.

In order to distinguish between the recent so-called "plastic paints," and coatings which really do contain a major portion of raw materials as defined and used in the plastics industry, the suggestion has been made that if the soluble solids of the coating in question contain more than 75 percent of one or more of the following raw materials it should be entitled to the plastics classification: benzylcellulose, nitrocellulose, ethylcellulose, cellulose acetate, cellulose acetobutyrate, cellulose acetopropionate, urea-formaldehyde, melamine resin, alkyd resin, vinyl or vinylidine resin, polystyrene resin, acrylic acid resin, polyvinylbutyl resin, phenolic resin, allyl resin and chlorinated rubber. There may be other raw materials used in plastics that should be included, but the list is fairly representative.

While the Bureau has examined a number of so-called "plastic paints," it is regretted that we have no published information on various brands.

Through the courtesy of the National Paint, Varnish and Lacquer Association, we are inclosing a copy of Circular 701, Plastic Paint Tests.

Circular 701 Issued January, 1945

Scientific Section
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National Paint, Varnish and Lacquer Association, Inc.
WASHINGTON, D. C.

PLASTIC PAINT TESTS

M. W. Westgate, L. P. Hart, H. A. Gardner

"Plastic" is not a new word in the paint industry. Technically all paints may have certain plastic properties, but if the word "plastic" is an excuse for exaggerated claims or unusual prices, then certainly this is another matter.

In view of the recent appearance on the market of a considerable group of coatings described as "plastic paints," for which unusual qualities are claimed and which are generally offered at unusually high prices, many samples were gathered and examined by our laboratory. The purpose was to determine whether these highly advertised products could justify the unusual claims which have been made as to their physical properties. Accordingly the products were very fully tested in comparison with regular moderately priced paints for such practical properties as the public would be interested in, including hiding power, gloss, ease of brushing, abrasion resistance, hardness, scrub resistance, resistance to chemicals, etc. This investigation is naturally being continued as additional samples are secured. The results of the tests have been placed in chart form for purposes of comparison, so that the "plastic" products may be compared with "regular" products.

The data in the accompanying tables indicate that none of the so-called "plastic" paints examined has unusual properties. Most of them appear to be no better than, and in some instances not so good as regular moderately priced trade sales items such as have been marketed in paint stores throughout the country for many years.

As is well known, wall paints with non-flowing properties, similar in some respects to plaster, applied at times with a trowel were in vogue even two decades ago and probably are still in public use. They were called "plastic paints" and "texture paints." Indeed, the words "plaster" and "plastic" are both derived from the Greek (they had a word for it) "plastikos," meaning to mold or to form. Paints, although having "plasticity," cannot ordinarily be molded or formed like a true plastic when applied and dried on a surface.

One of the important developments during recent years is the tremendous use of "plastics" for the production not only of household articls and other articles in common use, but for military equipment as well. Space permits reference only to a very few, such as cups, trays, toilet accessories, containers, caps and closures, clock cases, radio cabinets,, tool handles, umbrella handles, etc. Non-shattering transparent noses for airplanes, helmet liners, carrying cases, instrument dials and many other articles made of moldable or extruded plastics formed under heat and pressure now serve our Armed Forces. In view of the great diversity of such articles, and their extensive use, it may be expected that a substantial portion of the public now associates the word "plastic" with such molded articles, knows little or nothing of the variety of materials from which they are made, and is interested principally in their physical characteristics. To manufacturers of "plastic paint" any conception of the word "plastic" such as might be held by chemists and technicians appears to be of less importance than the impression on the public mind which may be created by the use of the description "plastic" applied to paint.

It also is not new that similar plastic substances may occasionally be used in paints and varnishes as well as in molded plastics. The granddaddy of modern plastics is celluloid, a blend of cellulose nitrate and camphor. Cellulose nitrate has been used in lacquers for 50 years or more and is still an important ingredient of modern lacquers. Phenolic resin, another plastic, has been used for 30 years for making molded articles. Different forms of phenolic resin have been used for over 20 years in paints and varnishes. Alkyd resins were originally made for plastic uses many years ago, but their greatest use has been, and still is, in paints, varnishes, and lacquers. On the other hand, many substances used as plastics are not used extensively in paint and varnish because they have no outstanding film properties, because satisfactory solvents are not available or because of other reasons.

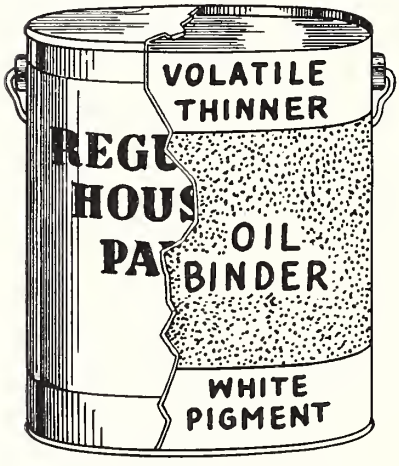
During the war the phenolics, alkyds and other synthetic resins have been under strict allocation and their use has been limited to military requirements and a few civilian finishes of the highest degree of essentiality; they have not been, and are not available, for paint products for general consumption.

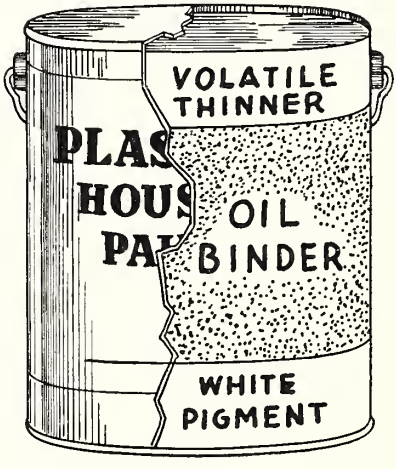
If such materials were readily available there would still remain the question whether paints containing them in varying quantities produced the results which the public may expect, either because of its familiarity with the original meaning of the word "plastic" or its possibly greater familiarity with modern molded plastic articles. That question, involving as it does a knowledge of the state of the public mind, must be left unanswered, at least for the time being.

EXTERIOR HOUSE PAINT WHITE

	REGULAR NO. 10	PLASTIC NO. 34	PLASTIC NO. 22	PLASTIC NO. 4
Body	Medium	Full	Heavy	Medium
Hiding Power Average	235	234	167	246
Gloss	60	58	41	83
Brushability	Fair	Fair	Very Poor	Poor
Composition: Pigment, %	65*	68.5*	65*	64.0*
Volatile Thinner, %	10.5	10.5	8	10.0
Oil, %	24.5	21	27	26.0

*The composition of the pigment portion of these four paints was as follows: No. 10—60% lead and zinc, 40% titanium-magnesium. —No. 34—62% lead and zinc, 12% TiO_2, 26% inert. —No. 22—38% lead and zinc, 6% TiO_2, 56% inert. —No. 4—70% lead and zinc, 7% TiO_2, 23% inert.





A *regular* brand of house paint, such as may be found in practically any paint store in the United States, was compared in composition with 2 brands of *plastic* house paint—Nos. 4 and 34. They were found to be very similar in content of white pigment, character of pigments, oil binder, and of volatile thinner. The cost per gallon of the ingredients in each paint was within a few pennies of the same figure. No unusual materials, such as phenolic resins, alkyds, or other synthetics, were present in either paint. From the composition, it could fairly be stated that they would give equal service. One other brand of *plastic house paint* No. 22 *was found to be inferior* in quality and much lower in cost of raw materials.

INTERIOR WHITE ENAMELS

	REGULAR NO. 3	PLASTIC NO. 5	REGULAR PAINT NO. 38	PLASTIC PAINT NO. 19
Body	Thin	Medium	Full	Medium
Hiding Power Average	460	156	190	349
Gloss	87	84	52	91
Brushability	Good	Poor	Good	Fair
Scrub Resistance	Fair	Good	Fair	Fair
Bending Test	Passed O.K.	Failed B'dly	Slgt. Fail.	Failed
Hardness	20	11	5	9
Composition:				
Pigment, %	30.0*	44	54*	46
Volatile Thinner, %	37.8	24	27	21
Oils & Resins, %	32.2	32	19	33

*TiO_2 100%.

Remarks: "Regular" enamel No. 3 appears superior to the others.

INTERIOR GLOSS WHITES

	REGULAR NO. 27	PLASTIC NO. 15
Body	Medium	Medium
Hiding Power Average	251	288
Gloss	88	87
Brushability	Fair	Fair
Scrub Resistance	Good	Fair
Bending Test	Passed O. K.	Passed O. K.
Hardness	5	11
Resistance to Acid	Fair	Good
Resistance to Alkali	Fair	Fair
Resistance to Alcohol	Fair	Good
Composition: Pigment, %	47	43
Volatile Thinner, %	21	27
Oils—Resins, %	32	30

Remarks: These two gloss whites are about equal.

INTERIOR GLOSS WHITE

	REGULAR NO. 26	PLASTIC NO. 23
Body	Med. Full	Thin
Hiding Power (Average)	132	155
Gloss	84	77
Brushability	Fair	Good
Scrub Resistance	Superior	Good
Bending Test	Passed O. K.	Passed O. K.
Hardness	3	13
Resistance to Acid	Good	Fair
Resistance to Alkali	Good	Poor
Resistance to Alcohol	Good	Fair
Composition:		
Pigment, %	49	27
Volatile Thinner, %	19	41
Oils—Resins, %	32	32

Remarks: The "regular" is slightly superior to the "plastic" gloss white.

INTERIOR SEMI-GLOSS WHITE

	REGULAR NO. 2	PLASTIC NO. 16
Body	Medium	Heavy
Hiding Power (Average)	374	222
Gloss	38	31
Brushability	Good	Poor
Scrub Resistance	Fair	Fair
Bending Test	Failed	Failed
Hardness	11	8
Resistance to Acid	Poor	Poor
Resistance to Alkali	Poor	Poor
Resistance to Alcohol	Poor	Poor
Composition		
Pigment, %	46*	52
Volatile Thinner, %	36	20
Oils—Resins, %	18	28

*TiO_2 62%. Tical 11%. Inert 27%.

Remarks: The "regular" has better hiding power and brushability than the "plastic."

SEMI-GLOSS WALL PAINTS (WHITE)

	REGULAR PAINT NO. 40	PLASTIC PAINT NO. 20	REGULAR PAINT NO. 42	PLASTIC PAINT NO. 24
Body	Full	Full	Medium	Heavy
Hiding Power	182	234	280	226
Gloss	35	4	53	9
Brushability	Poor	Poor	Very Good	Poor
Scrub Resistance	Excellent	Very Good	Fair	Failed
Bending Test	O. K.	Bad Failure	Failed	Failed
Composition:				
Pigment, %	53.0*	63	58**	64
Volatile Thinner, %	25.7	17	24	24
Oils & Resins, %	21.3	20	18	12

*TiO_2 13. Tical 40. Lithopone 45. Inert 2. **Tical 65. Litho 25. Inert 10.

Remarks: The "plastic" semi-gloss paints—Nos. 20 and 24—had practically no gloss and were deficient in flexibility and brushability. The "regular" paints could be considered as superior to the "plastic" paints.

FLAT WALL PAINTS (WHITE)

	REGULAR PAINT NO. 41	PLASTIC PAINT NO. 21	REGULAR PAINT NO. 53	PLASTIC PAINT NO. 14	REGULAR PAINT NO. 37
Body	Medium	Heavy	Medium	Medium	Full
Hiding Power	175	237	426	305	210
Gloss	5	5	4	7	4
Brushability	Good	Fair	Good	Fair	Good
Scrub Resistance	Excellent	Failed	Fair	Failed	Fair
Bending Test	Failed	Failed	Passed	Bad Failure	Failed
Composition: Pigment, %	55*	60	67	60	58**
Volatile Liquid, %	32	25	24	21	30
Oils & Resins, %	13	15	9	19	12

*Tical 88. Inert 12. **Tical 60. Inert 40.

Remarks: The "regular" flat paints might be considered slightly superior to the "plastic" flats Nos. 21 and 14.

HOUSEHOLD WHITE ENAMELS

	REGULAR NO. 11	PLASTIC NO. 8	PLASTIC NO. 9
Body	Medium	Medium	Medium
Hiding Power Average	245	328	310
Gloss	91	86	89
Brushability	Fair	Good	Fair
Scrub Resistance	Superior	Fair	Fair
Baking and Bending Test	Passed O. K.	Passed O. K.	Failed
Hardness	9	9	9
Resistance to Acid	Good	Fair	Poor
Resistance to Alkali	Poor	Fair	Fair
Resistance to Alcohol	Fair	Fair	Fair
Composition:			
Pigment, %	30*	40	35
Volatile Thinner, %	37	32	21
Oils & Resins, %	33	28	44

*TiO_2 100%.

Remarks: The first two products, No. 11 and No. 8, are about equal. They are better than "plastic" No. 9.

RED FLOOR ENAMELS

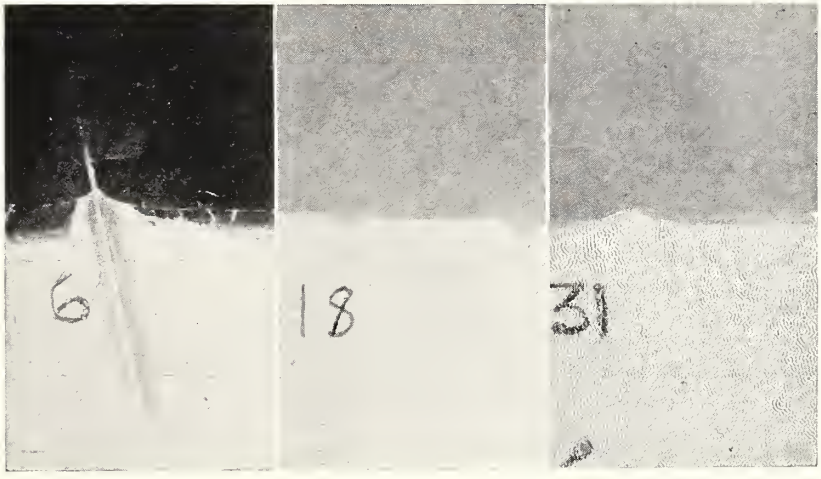
	REGULAR NO. 12	PLASTIC NO. 6
Body	Thin	Medium
Hiding Power	Very Good	Very Good
Gloss	93	82
Brushability	Good	Fair
Scrub Resistance	Good	Poor
Bending Test	Passed O. K.	Failed
Sand Abrasion	75,000 g.	55,000
Hardness	14	8
Resistance to Acid	Fair	Poor
Resistance to Alkali	Fair	Poor
Resistance to Alcohol	Fair	Poor
Resistance to Cold Water	O. K.	Failed Badly
Composition:		
Pigment, %	30.0	38.0
Volatile Thinner, %	33.6	30.4
Oils—Resins, %	36.4	31.6

Remarks: The "regular" floor enamel was greatly superior to the "plastic." The "plastic" enamel was very brittle and failed in cold water, acid, alkali and alcohol tests.

PIGMENTED FLOOR ENAMELS

	REGULAR NO. 28	PLASTIC NO. 18	PLASTIC NO. 31
Body	Medium	Medium	Full
Hiding Power Average	Very Good	Good	Very Good
Gloss	82	77	90
Brushability	Good	Fair	Fair
Washability	Good	Fair	Good
Bending Test	Passed O. K.	Failed	Failed Badly
Sand Abrasion	85,000	30,000	75,000
Hardness	7	7	10
Resistance to Acid	Fair	Poor	Poor
Resistance to Alkali	Poor	Poor	Poor
Resistance to Alcohol	Poor	Fair	Fair
Resistance to Cold Water	Good	Failed Badly	Failed Badly
Composition:			
Pigment, %	23	42	34
Volatile Thinner, %	39	24	35
Oils—Resins, %	38	34	31

Remarks: The "regular" floor enamel was superior to the "plastic" enamels. The latter was brittle and failed badly in cold water, becoming dull, spotted and weak.



WATER TEST: Three of the so-called "plastic" floor paints or enamels were coated on tin panels and allowed to age for 48 hours. The lower ends of the panels were then immersed in cold water for 24 hours. They turned white, became spotted, and the films were seriously affected. This is indicated in the above illustration of plastic enamels No. 6, 18 and 31.

CLEAR LINOLEUM QUICK DRY LACQUERS

	REGULAR NO. 36	PLASTIC NO. 33	PLASTIC NO. 25	PLASTIC NO. 7
Body	Thin	Thin	Thin	Thin
Gloss	65	35	55	50
Brushability	Good	Good	Good	Good
Scrub Resistance	Fair	Fair	Poor	Fair
Bending Test	Passed	Passed	Fail'd B'dly	Failed Badly
Sand Abrasion	15,000	15,000	10,000	5,000
Hardness	34	49	41	54
Resistance to Acid	Good	Good	Good	Good
Resistance to Alkali	Fair	Good	Good	Good
Resistance to Alcohol	Good	Good	Good	Good
Composition				
Volatile Thinner, %	85	85	85	86
Solids, %	15	15	15	14

Remarks: Very little difference between the "regular" and "plastic" finishes, except that two of the "plastics" failed badly in the flexibility test.

CLEAR FLOOR VARNISHES

	REGULAR NO. 29 FINISH	PLASTIC NO. 35 FINISH	PLASTIC NO. 17 FINISH
Body	E	A	E
Gloss	92	87	88
Brushability	Good	Good	Good
Bending Test	Failed	Failed	Failed
Sand Abrasion	75,000	85,000	55,000
Hardness	15	16	32
Resistance to Acid	Fair	Fair	Good
Resistance to Alkali	Fair	Fair	Good
Resistance to Alcohol	Poor	Fair	Fair
Resistance to Cold Water	Medium	Medium	Fair
Resistance to Boiling Water	Poor	Good	Poor
Composition:			
Volatile Thinner, %	50	40	49
Oils & Resins, %	50	60	51

Remarks: All three appeared to be about equal.

CLEAR VARNISHES

	REGULAR FINISH NO. 46	REGULAR FINISH NO. 44	REGULAR FINISH NO. 43	PLASTIC FINISH NO. 32
Body	G	G	D	A
Color	11	15	12	14
Gloss	90	93	92	90
Brushability	Good	Good	Good	Good
Bending Test	O. K.	O. K.	Failed	Failed
Sand Abrasion	120,000	155,000	75,000	50,000
Hardness	8	6	22	35
Resistance to Acid	Good	Good	Good	Good
Resistance to Alkali	Poor	Poor	Poor	Fair
Resistance to Alcohol	Good	Good	Good	Fair
Resistance to Cold Water	O. K.	O. K.	O. K.	O. K.
Resistance to Boiling Water	O. K.	O. K.	O. K.	O. K.
Composition:				
Volatile Thinner, %	40	44	49	63
Oils & Resins, %	60	56	51	37

Remarks: All four were about equal except that the "regular" varnishes were more flexible.

TEST METHODS

BODY. The body, or consistency, of the paints was evaluated in a practical manner by stirring with a paddle. The ratings were supplemented by exact measurements in a Mobilometer. In this device, the force required to squeeze the paints through holes in a disc is measured.

HIDING POWER. This was evaluated on both wet and dry films. On wet films the paint was applied by brush to a black and white area until the contrast was visually obliterated. The square feet per gallon of paint represents the hiding power. For the dry film values, three films of different spreading rates were applied by doctor blades to black and white surfaces. The contrast remaining on each of the surfaces was measured in a Reflectometer. The square feet per gallon for a 99% obliteration of the contrast was calculated. Since the wet and dry values were in good agreement, their average values are given in the table.

BRUSHABILITY. This was determined in a practical manner by brushing the paints on a sheet of wallboard 4 by 4 feet in size.

GLOSS. This was determined by means of the portable 60° Glossmeter on dry films, laid down by a doctor blade.

SCRUB RESISTANCE. Films of the paints were brushed on sandblasted iron panels at their normal spreading rate. After drying 7 days, they were scrubbed by hand, using a fibre brush and a 5% trisodium phosphate solution. One hundred strokes of the brush were applied to each film. Fresh washing solution was poured on the film at the end of 50 strokes.

BENDING TEST. This test was used to evaluate the ductility of the paints, the ability of the paints to follow changes in the dimensions of the supports on which they are applied. The paints were applied to tin plate panels with a doctor blade. After drying overnight, an accelerated aging of 5 hours at 105°C. was given to them. They were then allowed to cool for one hour and then were bent over a ⅛ inch rod.

ABRASION RESISTANCE. The ability of the floor finishes to resist abrasion was evaluated by a machine in which sand is allowed to drop on the film from a height of 3 feet. The amount of sand required to wear through the film is a measure of its abrasion resistance.

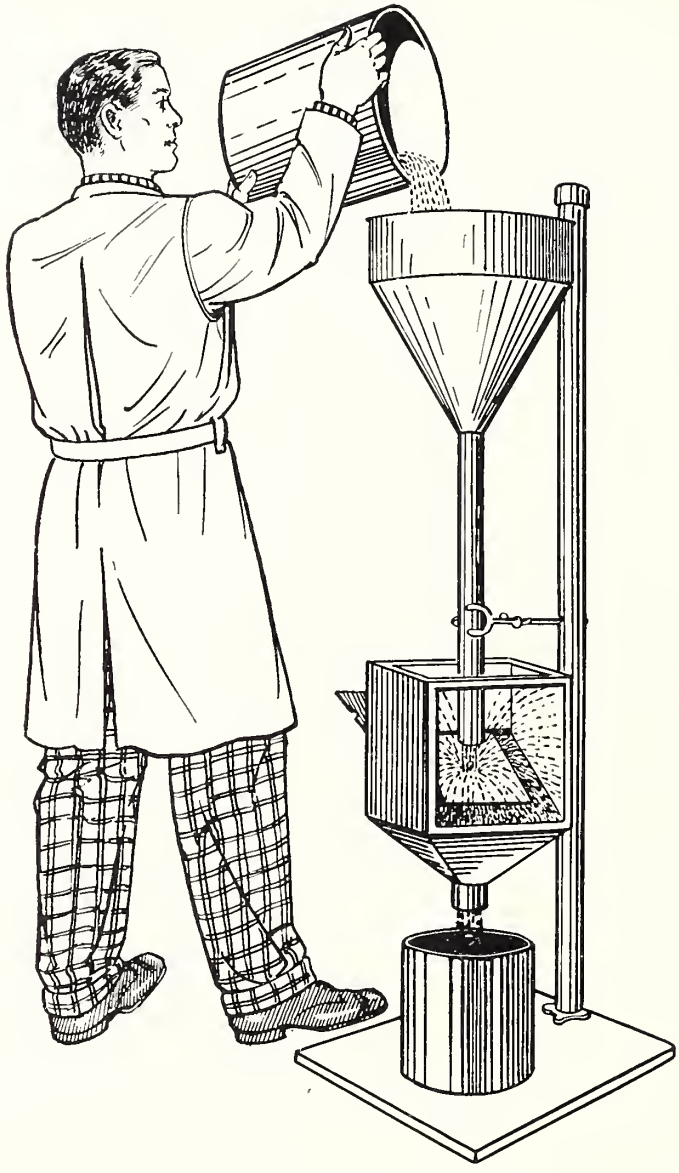
HARDNESS. Many different ideas regarding hardness are held by technologists, but the one used in this survey is known as the Rocker test. The Rocker, consisting of two thin parallel rings, is set to rocking on the film. The harder the film, the more oscillations the rocker will make before coming to rest. The values given in the table are to be compared with 100 for plate glass.

RESISTANCE TO ACID, ALKALI AND ALCOHOL. These tests were included because the "plastic" floor finishes are sometimes represented as exceptionally resistant to these agents. The agents used were sulfuric acid (5% in water), sodium hydroxide (2% in water), and ethyl alcohol (90 proof). An inert powder, barium sulfate, was mixed with these solutions to form pastes that would not flow. Dabs of these pastes were applied to the films, and covered with watch glasses. After 16 hours, the pastes were removed with running water and a camel's hair brush, and the effect on the film was recorded.

COMPOSITION. Standard methods of paint, varnish and lacquer analysis were applied.

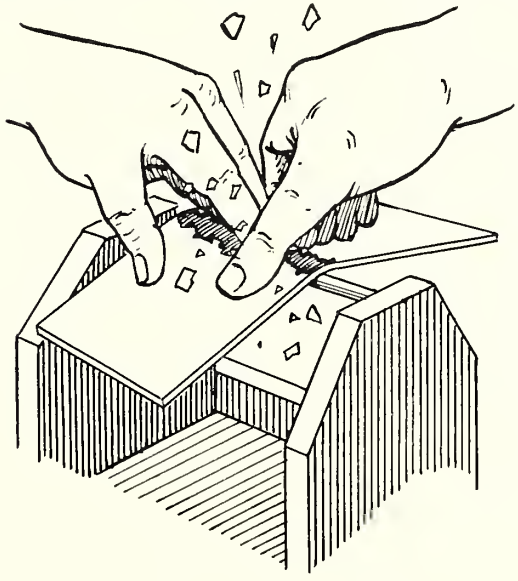
ILLUSTRATIONS OF TEST METHODS

BRUSHABILITY. All paints were brushed out upon large fibre boards having an area of about 16 square feet. This was done in a practical manner with a wall brush.

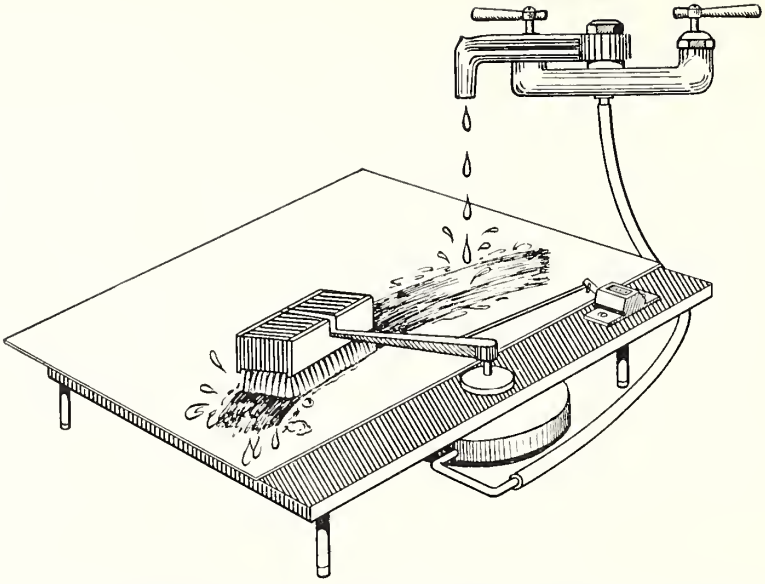


WEAR TEST FOR FLOOR FINISHES. Floor finishes were tested for their abrasion resistance by placing a coated panel in the abrasion resistance apparatus. Particles of sand impinge upon the surface, and the weight of sand in grams required to wear the coating through to the metal panel is an index of the wearability of the floor finish.

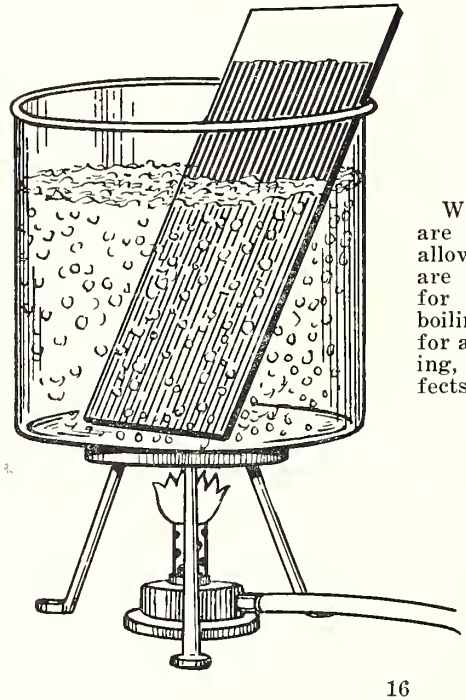
HIDING POWER. The hiding power of all paints was determined most accurately by the contrast ratio method, wherein lacquered sheets of paper in black-and-white patterns are coated with an accurate Bradley Blade, casting films 1½, 3 and 6 thousandths of an inch in thickness. The three sheets for each paint were then measured in an accurate photoelectric reflectometer and the contrast ratio calculated for *99% hiding*. This is the most exact method for determining hiding power.



ELASTICITY (BENDING TEST). Metal panels were coated with each of the finishes and after baking for 5 hours at 105° C. they were cooled and then bent over a rod ⅛ inch in diameter. If elastic, no breaks in the film or flaking would occur. With brittle finishes, cracks in the film or shattering would be indicated.



SCRUB RESISTANCE. Panels were coated with the various paints. After drying for five days, they were soiled with pencil marks, grease and ink. They were then scrubbed vigorously with pumice soap and water containing 5% tri-sodium phosphate for fifty rubs, using a stiff scrubbing brush. If not worn through, an additional fifty rubs were applied. As an additional test, an oscillating scrubbing brush, as illustrated above, was employed.



WATER TEST. Metal panels are coated with the finishes and allowed to dry for 48 hours. They are then immersed in cold water for a period of 24 hours or in boiling water, as indicated above, for a period of 15 minutes. Whitening, dulling, softening or other defects are noted.